

Sustainable Management of Pests and Improved Yield in Chinese Cabbage (*Brassica rapa subsp. chinensis*) by Black Soldier Fly Frass and Desmodium under Wonder Multistory Gardens.

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INTRODUCTION AND AIM

- ◆ Household vegetable production in sub-Saharan Africa is highly affected by poor soil fertility and prevalence of pests and diseases (Cobo et al., 2010; Tully et al., 2015; Mantovani et al., 2017; Wortmann et al., 2019).
- ◆ Lack of space for farming is the main challenge for vegetable farming by urban households.
- ◆ There is indiscriminate use of insecticides and inorganic fertilizers to increase productivity due to increased demand of vegetables as source of food and income.
- ◆ This reverses the benefit of organic farming and urban agriculture in improving food security and nutrition among urban households.
- ◆ The development of insect-based fertilizers that are safe for the environment as well as their application in different farming systems is necessary.
- ◆ Intercropping system by using companion crops present an alternative to pesticides and can be a viable agricultural practice to alleviate pest damages in organically produced crops.
- ◆ Cultivation of vegetable crops under innovative space/water /input efficient vertical farming systems that are suitable for urban settings can help improve nutrition and food security.
- ◆ Hence, this study used Desmodium and black soldier fly frass- as potential organic pest control and fertilizer sources for Chinese cabbage grown on low cost wonder multistory gardens.

METHOD

- Field trials done on wonder multistory gardens and the experimental design was randomized complete design (RCD). 8 treatments replicated three times.
- Chinese cabbage was the test crop. This is an exotic vegetable rich in vitamins with a very short maturity time.
- **Data collection:** Data on plant growth included plant height, number of leaves, leaf area, and chlorophyll SPAD values collected on weekly basis.
- **Pest incidences:** Number of pests was taken by counting the number of insects that can be seen physically on each plant and Pest damage score was taken using bioleaf analysis software. This is a non-destructive method for estimating the percentage damage of pests on each leaf.
- **Yield variable:** Marketable weight per plant was the above ground parts of the harvested cabbage. Number of damaged leaves. Counting the number of damaged leaves per harvested cabbage.
- **Data Analysis**
- The collected data was statistically analyzed using the R software. ANOVA and GLM techniques were used to test the significance of the data, Number of insects count were log (x+1) transformed. Tukeys test at P< 0.05 was used to compare the differences among treatment means.

RESULT AND DISCUSSION

Effect of Liquid BSFF, Powdered BSFF, NPK and Desmodium on Marketable Fresh Yield of Chinese cabbage

There was a general characteristic increase in the marketable weight of Cabbage in treatments with fertilizer application from control

Table 2: Fresh weight of Chinese cabbage under sole and intercropping systems at four fertilizer types (Liquid and powdered BSFF, NPK and No fertilizer).

Treatment	Fertilizer type	Marketable weight (kg. plant ⁻¹)
Sole cabbage	T0 Control	0.572±0.216e
	T1 Powdered BSFF	0.694±0.17cd
	T2 Liquid BSFF	0.913±0.880a
	T4 NPK	0.755±0.222c
Desmodium	T3 Control	0.780±0.179c
	T5 Powdered BSFF	0.648±0.174d
	T6 Liquid BSFF	0.820±0.850b
	T7 NPK	0.885±0.850b
<i>F value</i>		3.219
<i>SE</i>		2.865
<i>P<0.05</i>		0.00283*

Mean ±SE (n=10) values in each column followed by different letters indicate significant differences between treatments and (p<0.05).

- ◆ The combined treatment of desmodium and fertilizers liquid BSFF, powdered BSFF and NPK produced the highest marketable weight.
- ◆ The highest marketable weight was obtained in the liquid BSFF compared to combined application of liquid BSFF or NPK with desmodium (table I). It was hypothesized that there was a lower yield in combined application due to competition for nutrients and sunlight from between desmodium and cabbage.
- ◆ The liquid BSFF plants showed the best performance, including the thickness of the cabbage, the diameter of the cabbage and the total yield.

MATERIALS AND METHOD

Table I. Description of treatments used in the study

Treatment	Treatment composition
T1	Powdered BSF fertilizer (PBSFF)
T2	Liquid BSF fertilizer (LBSFF)
T3	Desmodium (D)
T4	Inorganic NPK (NPK)
T5	Combined Powdered BSF and Desmodium (PBSF+D)
T6	Combined Liquid BSF and Desmodium (LBSF+D)
T7	Combined NPK and Desmodium (NPK+D)
T0	Control (No amendment)



Figure 1. Chinese cabbage growing on wonder multistory garden with 6 terraces.

Results: Effect of Liquid BSFF, Powdered BSFF, NPK and Desmodium on Insect pest encounter and Damage on Chinese cabbage.

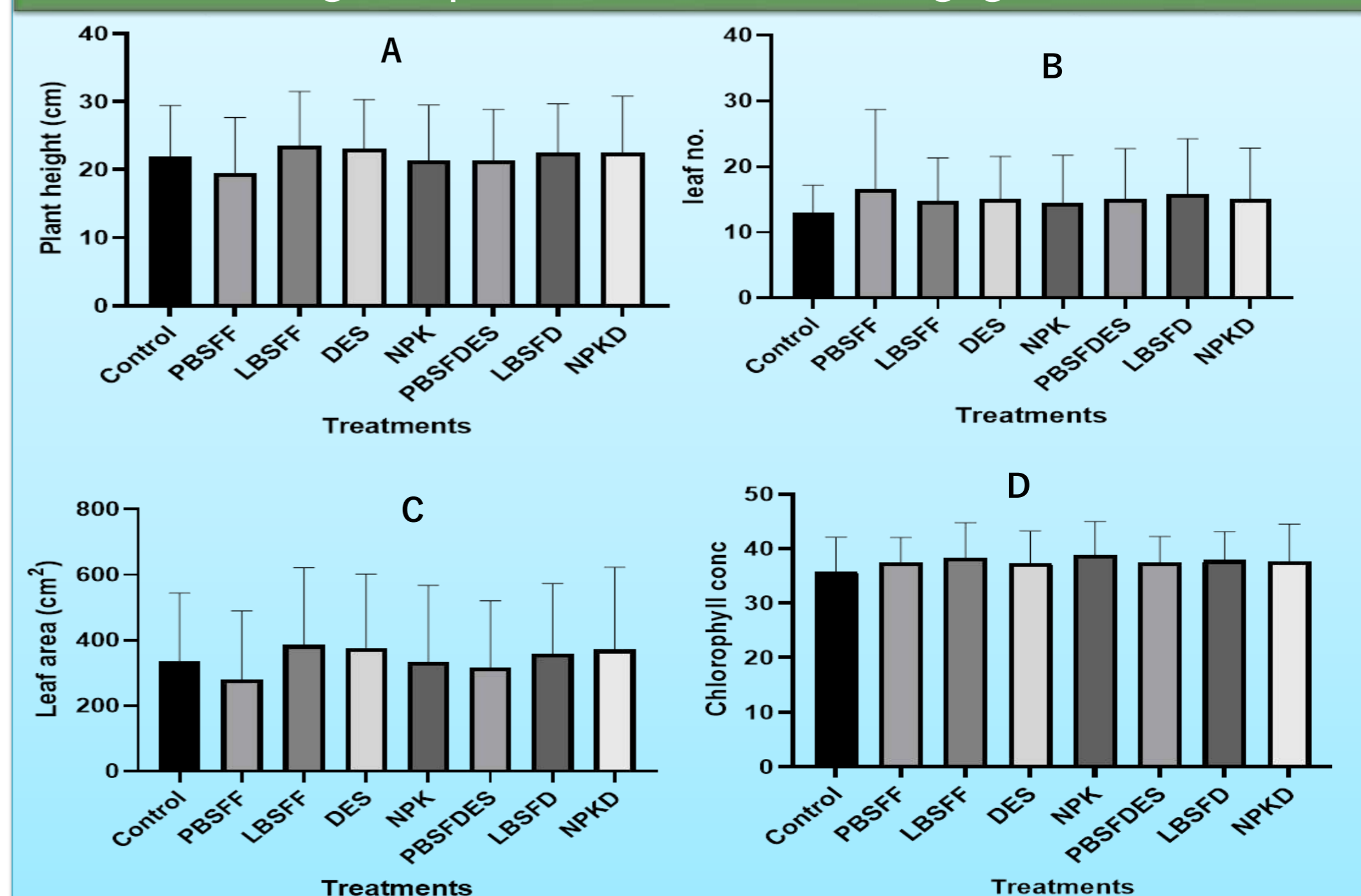
Table 3: Mean number of pests collected on Chinese cabbage

Treatment	Mean no. of pests
T1 PBSF	42.0c± 4.10
T2 LBSF	34.9cd± 2.49
T3 D	46.2c± 3.20
T4 NPK	94.8a± 3.50
T5 PBSF+D	26.7d±0.30
T6 LBSF+D	25.3d± 0.64
T7 NPK+D	70.1b±2.95
T0 Control	103.8a± 3.75
<i>F value</i>	25.7
<i>SE</i>	6.02
<i>(p<0.05)</i>	<0.0001*

Treatment	Mean damage score (%)
T1 PBSF	23.7c±0.028
T2 LBSF	22.1cd±0.105
T3 D	25.3c± 0.202
T4 NPK	44.6a ± 1.70
T5 PBSF+D	20.8c ± 0.00
T6 LBSF+D	17.3d± 0.33
T7 NPK+D	34.8b± 0.67
T0 Control	48.0a± 0.67
<i>F value</i>	20.93
<i>SE</i>	2.52
<i>(p<0.05)</i>	<0.0001*

Within columns means with the same letter are not significantly different P > 0.05. No amendment (T0), Powdered BSFF (T1), Liquid BSFF (T2), Desmodium (T3), inorganic (NPK=T4), Powdered BSF and Desmodium (T5), Liquid BSF and Desmodium (T6) and NPKand Des(T7).

Results: Effect of Liquid BSFF, Powdered BSFF, NPK and Desmodium on growth parameters of Chinese cabbage grown under WMSG



CONCLUSION

Desmodium crop have significant potential to attract natural enemies of pests that kill or suppress pests and reduce pest damage. Black soldier fly frass fertilizer contain chitin remains that have potential to manage arthropod pests (Tanga et al. (2019). The study showed that the integrating them is suitable for the improved growth and yield of Chinese cabbage under multistory garden with proper plant spacing. Black soldier fly fertilizers and desmodium have the potential to enhance yield in cabbage and to reduce the quantity and doses of fertilizer and pesticide use.

FUTURE WORK

- ◆ Intergration of desmodium and BSFFF and its effect on the nutritional qualities of yield and soil physical, chemical and microbial properties.

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